PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-284409
(43)Date of publication of application : 15.10.1999

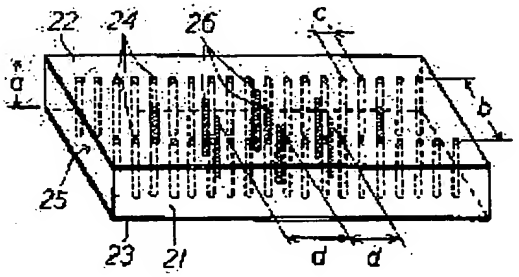
(51)Int.Cl. H01P 1/207
H01P 3/12

(21)Application number : 10-082184
(22)Date of filing : 27.03.1998

(71)Applicant : KYOCERA CORP
(72)Inventor : UCHIMURA HIROSHI

(54) WAVEGUIDE-TYPE BAND PASS FILTER

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a waveguide-type band pass filter whose productivity is high and which can correspond to miniaturization.
SOLUTION: A waveguide-type band pass filter is provided with a pair of main conductor layers 22 and 23, holding a dielectric substrate 21 and the sidewall through conductor groups 24 of two lines, which are formed by electrically connecting the main conductor layers 22 and 23 at the intervals of loss than half of a signal wavelength in a signal transmitting direction. A plurality of through conductors 26 for electrically connecting the main conductor layers 22 and 23 and forming introduction widows are arranged in a dielectric conductor line 25. Which transmits a high frequency signal by an area surrounded by the main conductor layers 22 and 23 and the sidewall through conductor groups 24 at the intervals of not more than the half of the wavelength in a pipe in the signal transmitting direction. Thus, the miniature waveguide-type band pass filter, whose productivity is high and which has a satisfactory characteristic, is provided.



LEGAL STATUS

[Date of request for examination]	15.03.2002
[Date of sending the examiner's decision of rejection]	05.08.2003
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
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CLAIMS

[Claim(s)]
[Claim 1] Provide a group and it changes. the penetration for side attachment walls of two trains which connected between said initiative body whorls in the initiative body whorl and the direction of a signal transmission of the pair which pinches a dielectric substrate electrically less than [of signal wave length] at intervals of 1/2, and were formed in them -- a conductor -- said initiative body whorl and the penetration for side attachment walls -- a conductor -- inside the dielectric-waveguide track which transmits a RF signal by the field surrounded by the group two or more penetration which connects between said initiative body whorls electrically, and forms an inductive window -- the waveguide mold band-pass filter characterized by arranging the conductor in said direction of a signal transmission less than [of the guide wave length] at intervals of 1/2.
[Claim 2] between said initiative body whorls -- said penetration for side attachment walls -- a conductor -- the waveguide mold band-pass filter according to claim 1 characterized by forming in said initiative body whorl and parallel the subconductor layer electrically connected with the group.
[Claim 3] said subconductor layer installs in the interior of said dielectric-waveguide track -- having -- said penetration -- it connects with a conductor electrically -- having -- this penetration -- the waveguide mold band-pass filter according to claim 2 characterized by forming said inductive window with the conductor.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the waveguide mold band-pass filter using the dielectric-waveguide track which mainly transmits RF signals, such as microwave and a millimeter wave.
[0002]
[Description of the Prior Art] In recent years, research of the mobile communications using RFs, such as microwave and a millimeter wave, the radar between vehicles, etc. is advanced briskly. The band-pass filter which lets only the RF signal of a specific frequency pass is required for the technique using these RFs.
[0003] Although there is a thing of various configurations in the band-pass filter for RFs, the waveguide mold band-pass filter using rectangular waveguide as what has a good band-pass response is known. There is a thing of structure as shown in drawing 6 and drawing 7 with an outline perspective view in this.
[0004] The thing of the structure shown in drawing 6 forms a band-pass filter by arranging perpendicularly the short pins 2 (2a-2e), such as two or more metal rods which form an inductive window in the interior of rectangular waveguide 1, in the direction of a signal transmission less than [of guide wave length lambdag] at intervals of [d] 1/2 (d<lambdag/2).
[0005] According to this structure, the width of face of a waveguide is divided by short pin 2c or the short pin groups 2a-2e of a waveguide which are in a center section mostly 1/2 or less [of cutoff wave length]. Consequently, the electromagnetic wave which has spread the waveguide by the short pin 2 is field L1 -L4 shown all over this drawing since it was reflected. It can be regarded as the space closed electrically. This closed space has the resonance mode of a proper, and when that die-length d is lambdag/2, it functions as a resonator which causes resonance on the lowest frequency. In the case of the structure shown in drawing 6 , four resonators formed with the wall by the short pin 2 can regard it as what is combined with the serial to a waveguide.
[0006] The electromagnetic wave which has spread the waveguide 1 from the input side of the left in drawing 6 as mentioned above is the resonance field L1 by association electromagnetic from between short pin 2a (inductive window) when in agreement with the resonance frequency of a proper which the resonator which the frequency of the electromagnetic wave mentioned above has although it becomes impossible to spread by short pin 2a. Energy flows. the same -- carrying out -- L1 from -- L2 L2 from -- L3 L3 from -- L4 Energy spreads and it spreads as an electromagnetic wave again from the output side of the method of the right in drawing 6 of a waveguide 1. Therefore, only an electromagnetic wave with the frequency of a proper can pass through the field by such structures, and, thereby, operates as a band-pass filter.
[0007] In addition, resonance field L1 -L4 mentioned above Since there is an inductive window for association, generally those die-length d becomes shorter than lambdag/2.
[0008] Moreover, the thing of the structure shown in drawing 7 forms a band-pass filter by similarly arranging perpendicularly the short plates 3, such as two or more metal plates which form an inductive window (inductive wall) in the interior of rectangular waveguide 1, in the direction of a signal transmission less than [of guide wave length lambdag] at intervals of [d] 1/2 (d<lambdag/2).
[0009] According to this, it becomes a band-pass filter by working completely like the short plate 3, the short pin 2 which the inductive window by it mentioned above, and its clearance.
[0010]
[Problem(s) to be Solved by the Invention] The band-pass filter by the conventional rectangular waveguide with such structure had the trouble that processing at the time of production was difficult, although the band-pass response over a RF signal was excellent. For this reason, there was a trouble that cost became [productivity] low highly as a result.

[0011] Moreover, since the size of the rectangular waveguide itself was large, the band-pass filter using this also became big, and the trouble of being difficult also had the miniaturization for using for mobile communications, the radar between vehicles, etc.
[0012] It is [0013] which this invention is thought out in view of the above-mentioned situation, and is for the purpose to offer the waveguide mold band-pass filter with which productivity can respond also to a miniaturization highly.
[Means for Solving the Problem] this invention persons replace with the conventional rectangular waveguide, as a result of repeating examination to the above-mentioned trouble. As [show /, respectively / to drawing 4 and drawing 5 / an outline perspective view] the penetration for side attachment walls of two trains which connected between initiative body whorls electrically less than [of signal wave length] at intervals of 1/2, and were formed in the direction of a signal transmission into the dielectric substrate pinched by the initiative body whorl of a pair -- a conductor -- by the group The dielectric-waveguide track (refer to JP,6-53711,A and Japanese Patent Application No. No. 229925 [eight to]) in which the side attachment wall of a waveguide was formed is used. two or more penetration equivalent to the short pin which forms an inductive window in the interior of the dielectric-waveguide track -- by forming a conductor and arranging in the direction of a signal transmission less than [of the guide wave length] at intervals of 1/2 It found out that the same waveguide mold band-pass filter as the structure shown in drawing 6 and drawing 7 using the dielectric-waveguide track could be manufactured.
[0014] The initiative body whorl of the pair to which the waveguide mold band-pass filter of this invention pinches a dielectric substrate, Provide a group and it changes. the penetration for side attachment walls of two trains which connected between said initiative body whorls in the direction of a signal transmission electrically less than [of signal wave length] at intervals of 1/2, and were formed in it -- a conductor -- said initiative body whorl and the penetration for side attachment walls -- a conductor -- inside the dielectric-waveguide track which transmits a RF signal by the field surrounded by the group two or more penetration which connects between said initiative body whorls electrically, and forms an inductive window -- it is characterized by arranging the conductor in said direction of a signal transmission less than [of the guide wave length] at intervals of 1/2.
[0015] moreover, the waveguide mold band-pass filter of this invention -- the above-mentioned configuration -- setting -- between said initiative body whorls -- said penetration for side attachment walls -- a conductor -- it is characterized by forming in said initiative body whorl and parallel the subconductor layer electrically connected with the group.
[0016] furthermore, in the waveguide mold band-pass filter of the above-mentioned configuration with which the subconductor layer was formed, said subconductor layer installs the waveguide mold band-pass filter of this invention in the interior of said dielectric-waveguide track -- having -- said penetration -- it connects with a conductor electrically -- having -- this penetration -- it is characterized by forming said inductive window with the conductor.
[0017]
[Embodiment of the Invention] Hereafter, it explains, referring to a drawing about the waveguide mold band-pass filter of this invention.
[0018] Drawing 4 and drawing 5 are the outline perspective views showing the configuration of the dielectric-waveguide track used for the waveguide mold band-pass filter of this invention, respectively. the initiative body whorl of the pair to which 11 pinches a dielectric substrate and 12-13 pinches the dielectric substrate 11 in these drawings, and the penetration for side attachment walls of two trains which 14 connected between the initiative body whorls 12.13 in the direction of a signal transmission electrically less than [of signal wave length] at intervals of 1/2, and were formed -- a conductor -- it is a group.
[0019] According to drawing 4 and drawing 5 , the initiative body whorl 12-13 of a pair is formed in the location which pinches the dielectric substrate 11 of predetermined thickness a, and the initiative body whorl 12-13 is formed in the vertical side of the dielectric substrate 11 which faces across a waveguide track formation location at least. moreover, the through hole which connects the initiative body whorls 12 and 13 electrically between the initiative body whorls 12.13 -- a conductor and a beer hall -- penetration of a conductor etc. -- many conductors prepare -- having -- the penetration for side attachment walls of two trains -- a conductor -- the group 14 is formed.
[0020] the penetration for side attachment walls of two trains -- a conductor -- a group 14 has the predetermined spacing (width of face) b, is formed in the direction of a signal transmission with less than 1/2 predetermined spacing c of signal wave length, and, thereby, forms the side attachment wall in this dielectric-waveguide track.

[0021] Although there is especially no limit to spacing between thickness [of the dielectric substrate 11] a12.13, i.e., the initiative body whorl of a pair, here Are good to consider as about 1/2 and about 2 times to spacing b, in using by the single mode. the part which is equivalent to the H plane of a dielectric waveguide, and the Eth page in the example of drawing 4 and drawing 5 -- respectively -- the initiative body whorl 12-13 and the penetration for side attachment walls -- a conductor -- it forms by the group 14 -- having -- spacing b -- receiving -- thickness a -- about 2 times -- then the part which is equivalent to the Eth page and H plane of a dielectric waveguide -- respectively -- the initiative body whorl 12-13 and the penetration for side attachment walls -- a conductor -- it will be formed by the group 14. moreover, the thing for which spacing c is set as less than 1/2 spacing of signal wave length (cutoff wave length) -- the penetration for side attachment walls -- a conductor -- the group 14 forms the electric wall.
[0022] since a TEM wave can be spread between the initiative body whorls 12.13 of the pair arranged in parallel -- the penetration for side attachment walls -- a conductor -- if the spacing c of a group 14 is larger than signal wave length, i.e., cutoff wave length, lambdac, even if it supplies electric power to this waveguide track in an electromagnetic wave, it will not spread along with the false waveguide made here. however, the penetration for side attachment walls -- a conductor -- if the spacing c of a group 14 is smaller than cutoff wave length lambdac, an electromagnetic wave cannot be perpendicularly spread to a waveguide track, but it will be spread in the direction of a signal transmission of a waveguide track, reflecting. consequently -- according to the configuration of drawing 4 and drawing 5 -- the penetration for side attachment walls of the initiative body whorl 12-13 of a pair, and two trains -- a conductor -- the field of the size of axb serves as [the cross section surrounded by the group 14] the dielectric-waveguide track 15.
[0023] 16 [in addition,] in drawing 5 -- the penetration for side attachment walls -- a conductor -- the penetration which forms each train of a group 14 -- a conductor -- it is the subconductor layer which connects comrades electrically and which was formed in parallel with the initiative body whorl 12-13, and is suitably formed of a request. if it sees from the interior of the dielectric-waveguide track 15 by forming such a subconductor layer 16 -- the side attachment wall of a track -- the penetration for side attachment walls -- a conductor -- by the group 14 and the subconductor layer 16, it becomes the shape of a fine grid and the shielding effect of the electromagnetic wave from a track can be heightened further.
[0024] moreover -- these modes -- the penetration for side attachment walls -- a conductor -- although the group 14 was formed in two trains -- this penetration for side attachment walls -- a conductor -- a group 14 -- four trains or six trains -- arranging -- the penetration for side attachment walls -- a conductor -- the false conductor by the group 14 -- forming a wall in three-fold [a duplex and] -- a conductor -- the leakage of the electromagnetic wave from a wall can be prevented more effectively.
[0025] According to the above-mentioned dielectric-waveguide track, since it becomes the transmission line by the dielectric waveguide, the waveguide size will become the magnitude of 1/rootepsilon of the usual waveguide, if specific inductive capacity of the dielectric substrate 11 is set to epsilon. Therefore, waveguide size can be made small and becomes magnitude available as the transmission line of the multilayer-interconnection substrate with which wiring is formed in high density, the package for semiconductor device receipt, or the radar between vehicles, so that an ingredient with large specific inductive capacity epsilon constitutes the dielectric substrate 11.
[0026] in addition, the penetration for side attachment walls -- a conductor -- the penetration which constitutes a group 14 -- in order to realize a good transmission characteristic, as for this spacing c, considering as fixed repeat spacing is desirable [the conductor is arranged as mentioned above less than / of cutoff wave length lambdac / at intervals of / c / 1/2, and], but if it is less than 1/2 spacing of cutoff wave length lambdac, it cannot be overemphasized that it may be made to change suitably or some values may be combined.
[0027] Although it does not divide and limit if it has the property which functions as a dielectric and does not bar transmission of a RF signal as a dielectric substrate 11 which constitutes such a dielectric-waveguide track, as for the dielectric substrate 11, from the point of the precision at the time of forming the transmission line, and the ease of manufacture, consisting of ceramics is desirable.
[0028] Although the ceramics with specific inductive capacity various until now as such ceramics is known, in order to transmit a RF signal on the waveguide track of this invention, it is desirable that they are paraelectrics. Generally this is because as for the ferroelectric ceramics dielectric loss becomes and transmission loss becomes large in a RF field. Therefore, specific-inductive-capacity epsilonr of the dielectric substrate 11 4-100 Extent is suitable.
[0029] Moreover, for the line breadth of the wiring layer generally formed in a multilayer-interconnection substrate, or the package for semiconductor device receipt or the radar between vehicles, specific inductive

capacity since it be about 1mm at the maximum be 100. When it use so that the upper part may become the electromagnetic-field distribution which an H plane, i.e., a field, roll in parallel with an upper field using an ingredient, the minimum frequency which can be used be computed with 15GHz, and become available also in the field of a microwave band. The dielectric which consists of resin generally used as a dielectric substrate 11 on the other hand is specific-inductive-capacity epsilonr. Since it is about two, when line breadth is 1mm, it cannot use, unless it is more than about 100 GHz.

[0030] Moreover, although there is much what has a very small dielectric dissipation factor in such paraelectrics ceramics like an alumina or a silica, all paraelectrics ceramics is not available. In the case of a dielectric-waveguide track, there is almost no loss by the conductor, most loss at the time of a signal transmission is loss by the dielectric, and the loss alpha by the dielectric (dB/m) is expressed as follows.

alpha=27.3xtandelta/[lambda/{1-(lambda/lambdac) 2} 1 / 2]

Inside of a formula, tandelta: Dielectric dissipation factor lambda of a dielectric : Wavelength lambdac in a dielectric : When it applies to the rectangular waveguide (WRJ series) configuration by which cutoff wave length standardization was carried out, it is {1-(lambda/lambdac) 2} 1/2 in an upper type. It is about 0.75.

[0031] Therefore, in order to carry out to below -100 dB/m that is the transmission loss with which practical use can be presented, it is required to choose a dielectric so that the following relation may be materialized.

[0032] f is a frequency (GHz) to be used among fxepsilon r 1 / 2 xtandelta<=0.8 type.

[0033] As such a dielectric substrate 11, there are alumina ceramics, crystallized glass, the alumimium nitride ceramics, etc., for example. The ceramic green sheet of two or more sheets is obtained by adopting a well-known doctor blade method, the well-known calendering roll method, etc. conventionally, and making this with the shape of a sheet, while carrying out addition mixing of the suitable organic solvent and solvent for ceramic raw material powder and making it slurry-like. For example, after an appropriate time, While performing suitable punching processing for each of these ceramic green sheet, the laminating of these is carried out. In the case of alumina ceramics, in the case of 1500-1700 degrees C and crystallized glass, it is manufactured by calcinating at the temperature of 1600-1900 degrees C in the case of 850-1000 degrees C and the alumimium nitride ceramics.

[0034] Moreover, when the dielectric substrate 11 consists of alumina ceramics as an initiative body whorl 12-13 of a pair, for example, By thick film printing, at least, what carried out addition mixing of oxides, an organic solvent, solvents, etc., such as a suitable alumina silica magnesia for metal powder, such as a tungsten, and was made into the shape of a paste is printed on a ceramic green sheet so that the transmission line may be covered completely. After an appropriate time, It calcinates at about 1600-degree C elevated temperature, and as it becomes the thickness of 10-15 micrometers or more, it forms. In addition, in the case of crystallized glass, in the case of the alumimium nitride ceramics, as metal powder, tungsten molybdenum is suitable for copper, gold, and silver. Moreover, generally thickness of the initiative body whorl 12-13 is set to about 5-50 micrometers.

[0035] moreover, the penetration for side attachment walls -- a conductor -- the penetration which constitutes a group 14 -- as a conductor -- a beer hall -- a conductor and a through hole -- the cross-section configuration is [that what is necessary is just to form with a conductor etc.] also easy to manufacture -- it is circular and also you may be polygons, such as a rectangle and a rhombus. these penetration -- the metal paste same to the through tube which pierced the conductor for example, to the ceramic green sheet, processed, and was produced as the initiative body whorl 12-13 -- embedding -- the after an appropriate time and dielectric substrate 11 -- simultaneously, it calcinates and forms. in addition, these penetration -- a conductor -- diameters 50-300 mum is suitable.

[0036] Next, an example of the gestalt of operation of the waveguide mold band-pass filter of this invention using such a dielectric-waveguide track is explained based on drawing 1 and drawing 2 .

[0037] Drawing 1 is the outline perspective view showing an example of the gestalt of operation of the waveguide mold band-pass filter of this invention, and drawing 2 is a top view. The initiative body whorl of the pair which 21 pinched the dielectric substrate of thickness a, and 22 and 23 pinched the dielectric substrate 21, and was formed in these drawings, the penetration for side attachment walls of two trains which connected between the initiative body whorls 22.23 in the direction of a signal transmission electrically less than [of signal wave length (cutoff wave length lambdac)] at intervals of [c] 1/2 as 24 is also at the predetermined spacing (width of face) b, and were formed -- a conductor -- a group -- 25 -- the penetration for side attachment walls of the initiative body whorl 22-23 of a pair, and two trains -- a conductor -- it is the dielectric-waveguide track section constituted by the field surrounded by the group 24.

[0038] these dielectrics substrate 21, the initiative body whorl 22-23, and the penetration for side attachment walls -- a conductor -- a group 24 is constituted like the dielectric-waveguide track used for above-

mentioned this invention.
[0039] moreover, two or more penetration which 26 which gave and showed the slash all over these drawings connects electrically between the initiative body whorls 22.23 arranged in the interior of the dielectric-waveguide track 25 in the direction of a signal transmission less than [of guide wave length lambdag] at intervals of [d] 1/2 (d<lambdag/2), and forms an inductive window -- it is a conductor.
[0040] two or more penetration which forms an inductive window in the interior of the dielectric-waveguide track 25 in this way according to this invention -- it is about a conductor 26 also at less than 1/2 predetermined spacing d of guide wave length lambdag -- arranging -- these penetration -- by adjusting the number of conductors 26 The dielectric-waveguide track 25 constituted by the group 24 is equivalent to the rectangular waveguide 1 shown in drawing 6 . the penetration for side attachment walls of the initiative body whorl 22-23 of a pair, and two trains -- a conductor -- two or more penetration -- a conductor 26 becomes a thing equivalent to the short pin 2 shown in drawing 6 , and the same waveguide mold band-pass filter can be formed by the completely same principle as the waveguide mold band-pass filter using the rectangular waveguide shown in drawing 6 .
[0041] According to the waveguide mold band-pass filter of such this invention, since it becomes a dielectric waveguide and can produce small compared with the waveguide mold band-pass filter using the conventional rectangular waveguide, it can make in the dielectric substrate which constitutes a multilayer-interconnection substrate and the package for semiconductor device receipt, and the correspondence to a miniaturization serves as an easy waveguide mold band-pass filter. And since it is easily producible with sheet lamination techniques, such as a green sheet laminated layers method, it becomes the waveguide mold band-pass filter in which manufacture with it is possible. [high productivity and] [cheap]
[0042] two or more penetration which forms an inductive window in the waveguide mold band-pass filter of this invention -- the penetration which functions as a short pin when arranging a conductor 26 -- each spacing, a number, magnitude, etc. of a conductor 26 participate in a filter shape intricately. For this reason, the waveguide mold band-pass filter which has a desired band-pass response will be obtained by calculating repeatedly in electromagnetic-field analysis so that the filter shape demanded may be satisfied.
[0043] moreover, two or more penetration which forms an inductive window to the dielectric-waveguide track which showed the waveguide mold band-pass filter shown in drawing 1 and drawing 2 to drawing 4 -- the dielectric-waveguide track further shown in this at drawing 5 although it had become the configuration which arranged the conductor 26 -- like -- between the initiative body whorls 22.23 -- the initiative body whorl 22-23 -- parallel -- the penetration for side attachment walls -- a conductor -- the subconductor layer electrically connected with the group 24 may be formed. the case where a subconductor layer is formed such -- the penetration for side attachment walls -- a conductor -- the false conductor formed of a group 24 -- since a wall is strengthened as an electric wall, the transmission characteristic and shielding effect of an electromagnetic wave can be heightened further, and it becomes the waveguide mold band-pass filter which has a good band-pass response.
[0044] Next, the same top view as drawing 2 shows other examples of the gestalt of operation of the waveguide mold band-pass filter of this invention to drawing 3 . Drawing 3 is the top view showing the internal structure of the waveguide mold band-pass filter of this invention as well as drawing 2 , and has given the same sign to the same part as drawing 2 R> 2 in drawing 3 .
[0045] Drawing 3 realizes the configuration of the conventional waveguide mold band-pass filter shown in drawing 7 using the dielectric-waveguide track concerning this invention which has the subconductor layer 16 shown in drawing 5 as a dielectric-waveguide track. two or more penetration which 27 connects electrically between the initiative body whorls 22.23 arranged in the interior of the dielectric-waveguide track 25 in the direction of a signal transmission less than [of guide wave length lambdac] at intervals of [d] 1/2 in drawing 3 , and forms an inductive window -- a conductor -- it is -- penetration of these plurality -- as a conductor 27 forms the same inductive window as the short plate 3 shown in drawing 7 , it is arranged in the waveguide.
[0046] 28 is a subconductor layer and moreover, the subconductor layer 28 in this example the penetration for side attachment walls of two trains -- a conductor, while connecting with the group 24 electrically in each train It connects with a group 24 side electrically. the penetration for side attachment walls of the initiative body whorl 22-23 of a pair, and two trains -- a conductor -- two or more penetration which is installed in the interior of the dielectric-waveguide track 25 formed of the field surrounded by the group 24, and forms an inductive window -- a conductor 27 and each penetration for side attachment walls -- a conductor -- this installed part -- penetration -- the inductive window is formed with the conductor 27.
[0047] thus, two or more penetration -- it installs in a conductor 27 and the interior of the dielectric-

waveguide track 25 -- having -- these penetration -- by arranging the inductive window formed by the subconductor layer 28 electrically connected with the conductor 27 at the less than [of guide wave length lambdag] 1/2 predetermined spacing d The dielectric-waveguide track 25 constituted by the group 24 is equivalent to the rectangular waveguide 1 shown in drawing 7 R> 7. the penetration for side attachment walls of the initiative body whorl 22-23 of a pair, and two trains -- a conductor -- two or more penetration -- the inductive window formed of a conductor 27 and the subconductor layer 28 becoming a thing equivalent to the short plate 3 shown in drawing 7 , and by the completely same principle as the waveguide mold band-pass filter shown in drawing 6 and drawing 7 The waveguide mold band-pass filter using the rectangular waveguide shown in drawing 7 and the same waveguide mold band-pass filter can be formed.

[0048] Also with such a waveguide mold band-pass filter of this invention, the correspondence to a miniaturization is easy and serves as a waveguide mold band-pass filter in which manufacture with it is possible. [high productivity and] [cheap]

[0049] two or more penetration which forms an inductive window like this example -- the penetration mentioned above when a conductor 27 and the subconductor layer 28 were arranged -- the waveguide mold band-pass filter which has a desired band-pass response will be obtained using an analysis simulator so that the filter specification demanded may be satisfied like the case of a conductor 26.

[0050] in addition, two or more penetration -- a conductor 26-27 -- the penetration for side attachment walls -- a conductor -- penetration of a group 24 -- what is necessary is just to form as mentioned above like a conductor Moreover, the cross-section configuration is not restricted circularly, but is good according to a desired band-pass response also as an ellipse form, a triangle, a square and a polygon, or plate-like.

[0051] In addition, this invention is not limited to the example of the gestalt of the above operation, and performing modification and amelioration various in the range which does not deviate from the summary of this invention does not interfere at all. For example, although the resonance section considered as four steps (L1 -L4) of filters in the above example, according to the specification of a filter, it is good also as a multistage filter.

[0052]

[Effect of the Invention] According to the waveguide mold band-pass filter of this invention, as explained in full detail above inside a dielectric-waveguide track two or more penetration which connects electrically between the initiative body whorls of the pair which pinches a dielectric substrate, and forms an inductive window -- a conductor from having arranged in the direction of a signal transmission less than [of guide wave length lambdag] at intervals of 1/2 Since it becomes a dielectric waveguide and can produce small compared with the waveguide mold band-pass filter using the conventional rectangular waveguide, it can make in dielectric substrates, such as a multilayer-interconnection substrate. Since the correspondence to a miniaturization serves as an easy waveguide mold band-pass filter and it can moreover produce easily with sheet lamination techniques, such as a green sheet laminated layers method, it becomes the waveguide mold band-pass filter in which manufacture with it is possible. [high productivity and] [cheap]

[0053] moreover -- according to the waveguide mold band-pass filter of this invention -- between initiative body whorls -- the penetration for side attachment walls -- a conductor -- the case where the subconductor layer electrically connected with the group is formed in an initiative body whorl and parallel -- the penetration for side attachment walls -- a conductor -- the false conductor formed of a group -- since a wall is strengthened as an electric wall, the transmission characteristic and shielding effect of an electromagnetic wave can be heightened further, and it becomes the waveguide mold band-pass filter which has a good band-pass response.

[0054] furthermore, the penetration which according to the waveguide mold band-pass filter of this invention installs a subconductor layer in the interior of a dielectric-waveguide track, and forms an inductive window -- a conductor -- electric -- connecting -- penetration -- since the part of the conductor which forms an inductive window increases when an inductive window is formed with a conductor, concentration of the current to a conductor is eased and it has the more excellent property from loss of the energy by the conductor becoming small.

[0055] According to this invention, by the above, productivity was able to offer the waveguide mold band-pass filter which can respond also to a miniaturization highly as a waveguide mold band-pass filter using a dielectric-waveguide track.

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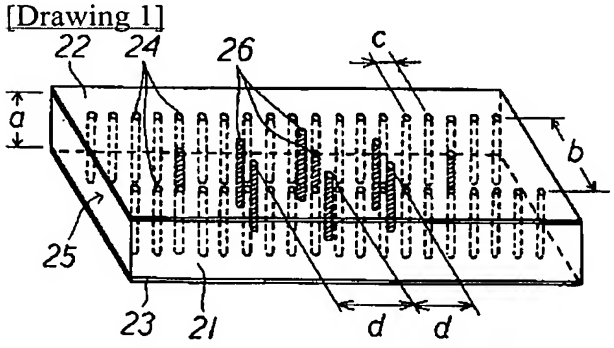
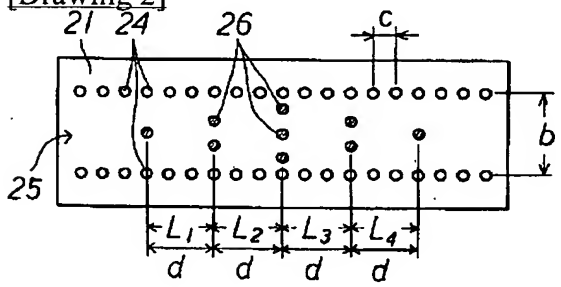
DRAWINGS

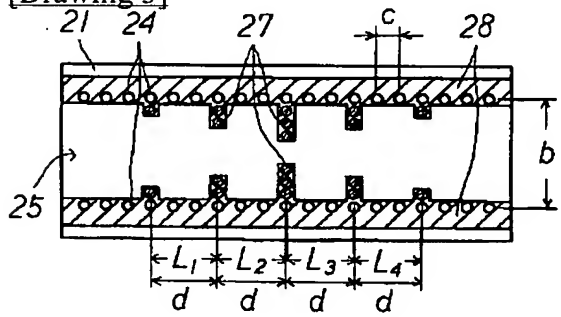
[Drawing 1]



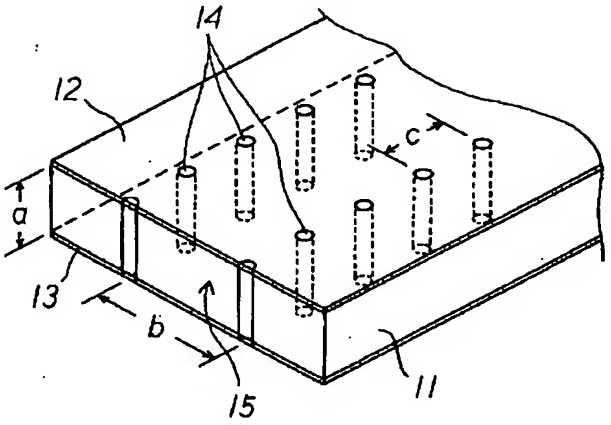
[Drawing 2]



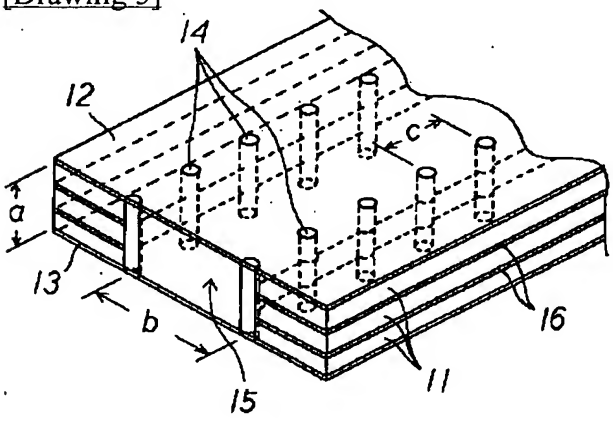
[Drawing 3]



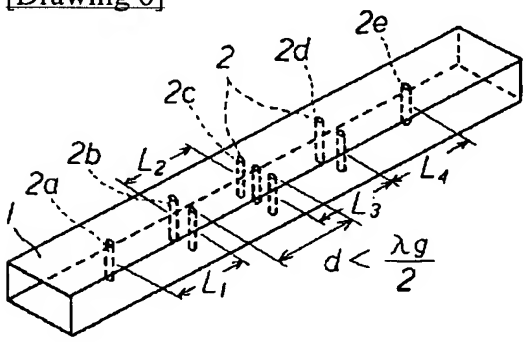
[Drawing 4]



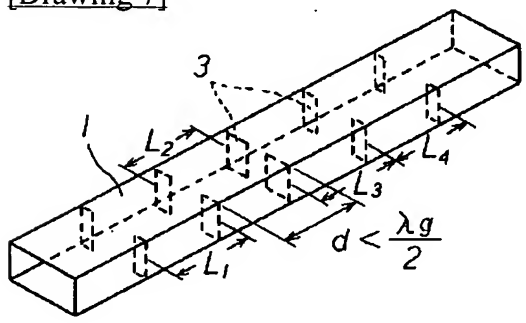
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]